



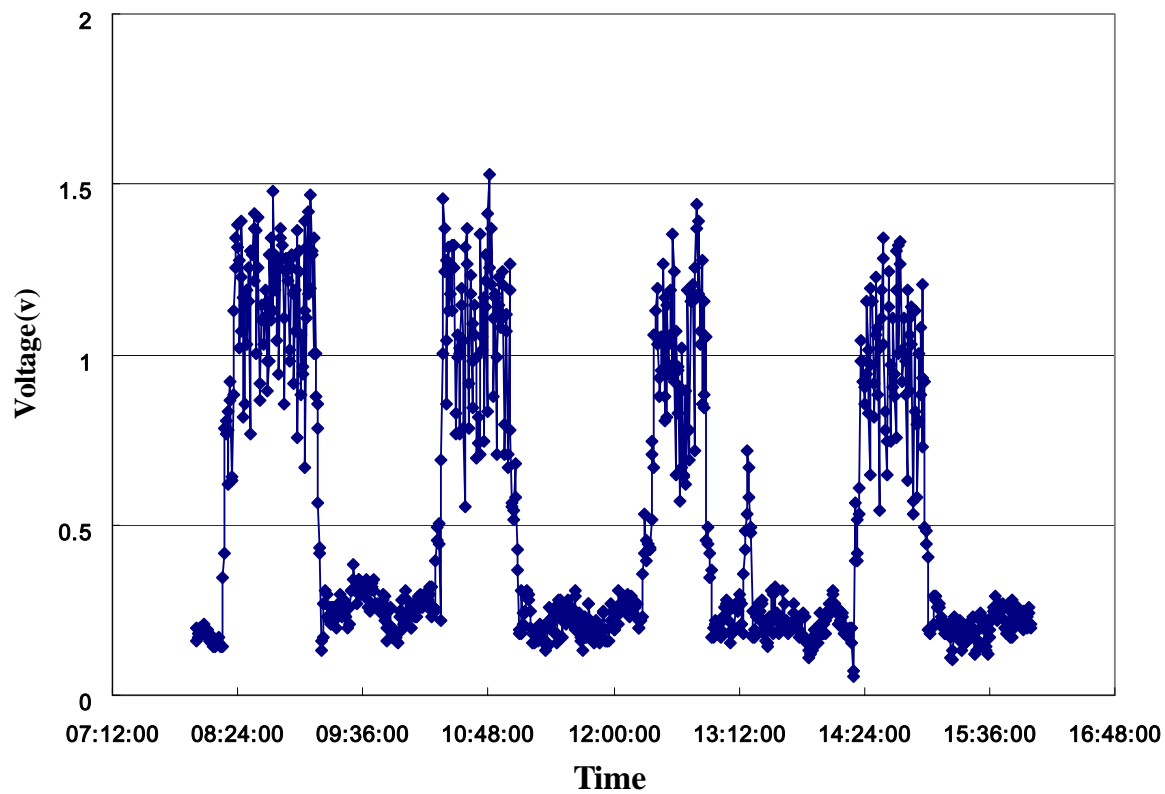
Integration of Activity Through Position

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National Central University, Taiwan
SWEETEK INC.

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Introduction



- We often want to know
 - Who are you ?
 - Where are you ?
 - How are you ?
 - What are you doing now ?
 - What's your exposed level ?
- Activity patterns associated with exposure levels are often important in the exposure assessment.
- **Images are essentials in behavior analysis, accident investigations and hazard preventions.**



Current Methods



- **TAP methods**
 - *Direct observation*
 - *Questionnaire*
 - *Activity daily record*
 - *Video monitoring*
 - *Infrared (IR) location system*
 - *Global position system (GPS)*
- **Limitations**
 - *Lack of accuracy*
 - *No real time data*
 - *Outdoor only*

What do we need?



- *Real-time data*
- *Precise location tracking (especially indoors)*
- *Handy devices (light, long battery life)*
- *Low cost and easy to use*

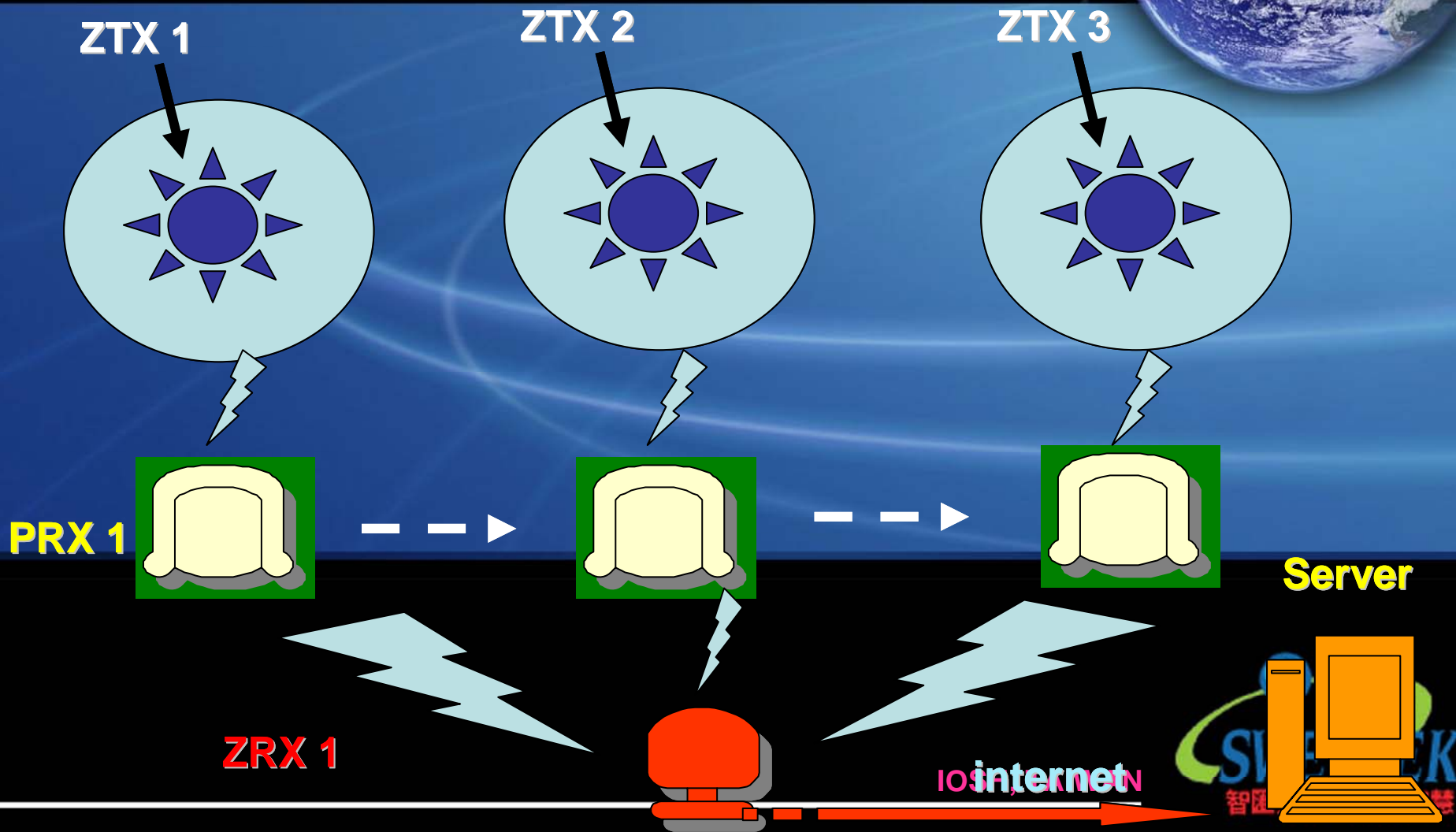
A New Approach



- **Locations** are determined based on wireless communications (Active RFID)
- **Activities** are recorded by digital video recorders only when workers are presented at the location.
- **Exposure levels** are monitored by proper sensors, such as noise meters or SnO₂ VOC sensors.
- **Data** are stored in either personal devices or servers.

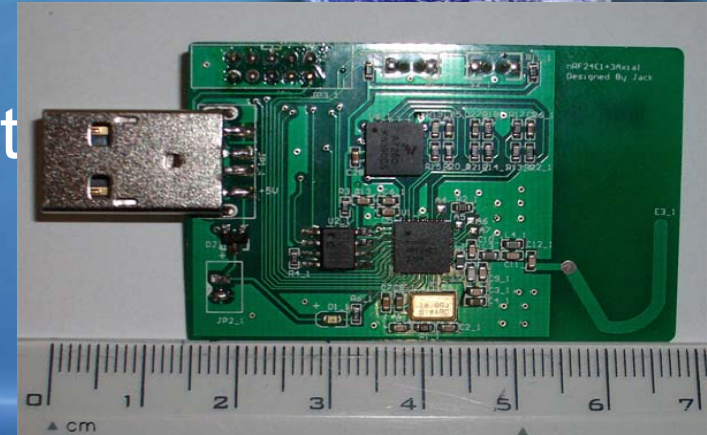
System Configuration

Micro-net communication



Devices

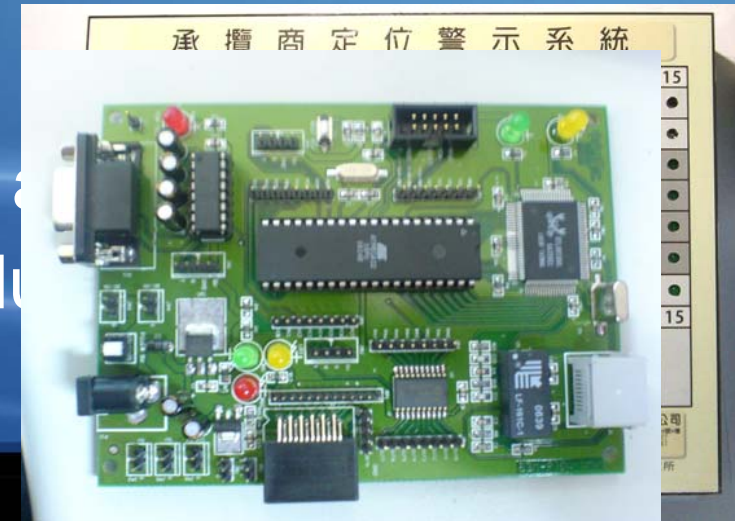
- **Zone Transmitter (ZTX):**
 - broadcast zone ID (4 bytes) to
 - range from 30cm to 60m
 - creates an invisible zone
- **Personal Receiver (PRX)**
 - listen to ZTX, and transmit Personal exposure data to ZRX
 - carried by workers, only 50g



Devices



- **Zone Receiver (ZRX)**
 - Receive data from PRX and transmit them to a network along with MAC address
- **Repeater (RPT)**
 - Relay PRX data until reach a
 - Range to 60m(2.4GHz module)
(433MHz module)
- **Field Display**
 - Display position data and alarm



Devices

- Sensors
 - Chemical Sensor (SnO_2)
 - Noise Meter
 - 3-axis Digital Accelerometer
- Video
 - IP-Based camera
 - Wireless camera
- Server
 - PC



Challenges

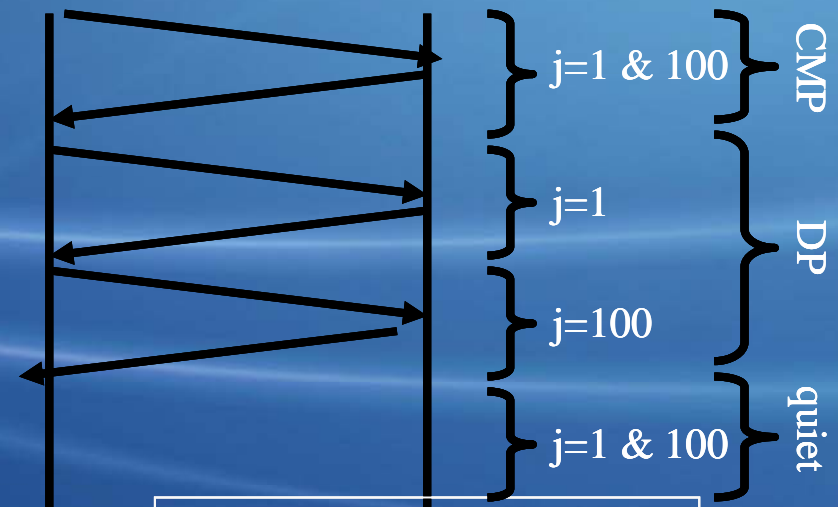
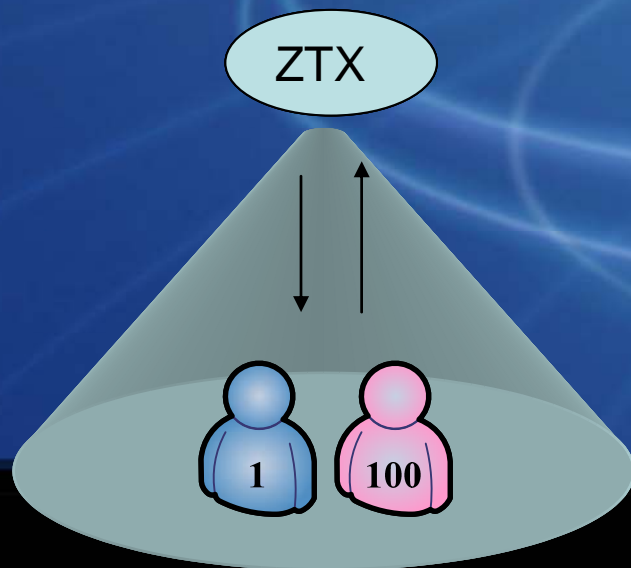


- Data Collision ?
- Roaming ability ?
- Power consumption ?
- Size and weight ?
- Installation and operation ?

Avoid Collisions?



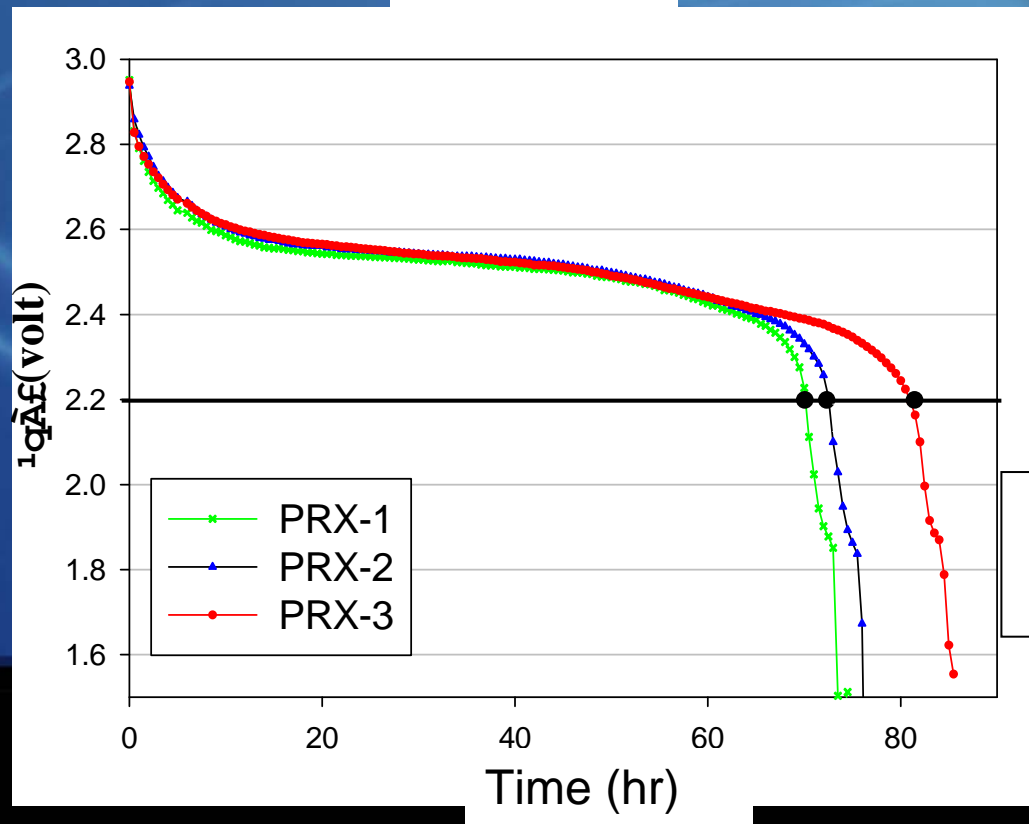
Listen-Talk-Quiet Protocol (LTQ)



LTQ Time Frames

Power Consumption

two 2500mA batteries

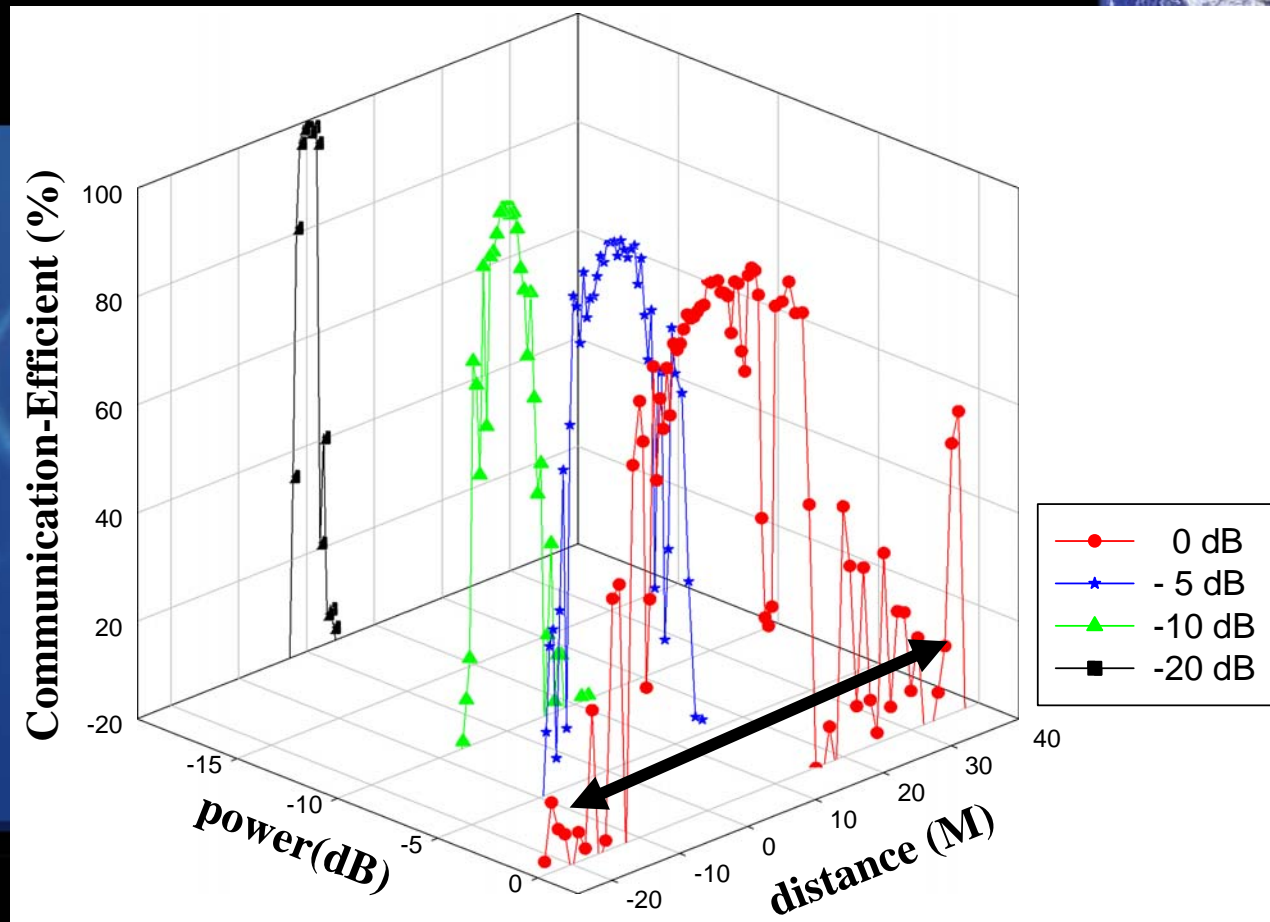


: 70 hr
: 73hr
: 80hr

at 1% duty cycle, battery life > 220 days

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RF Range

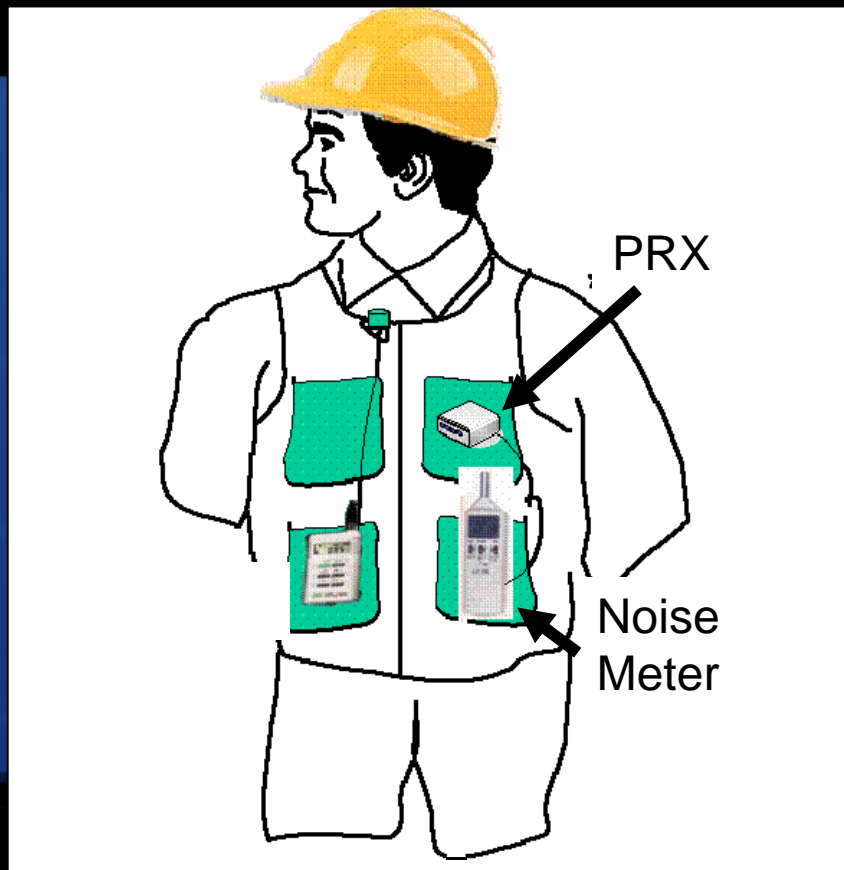


Examples

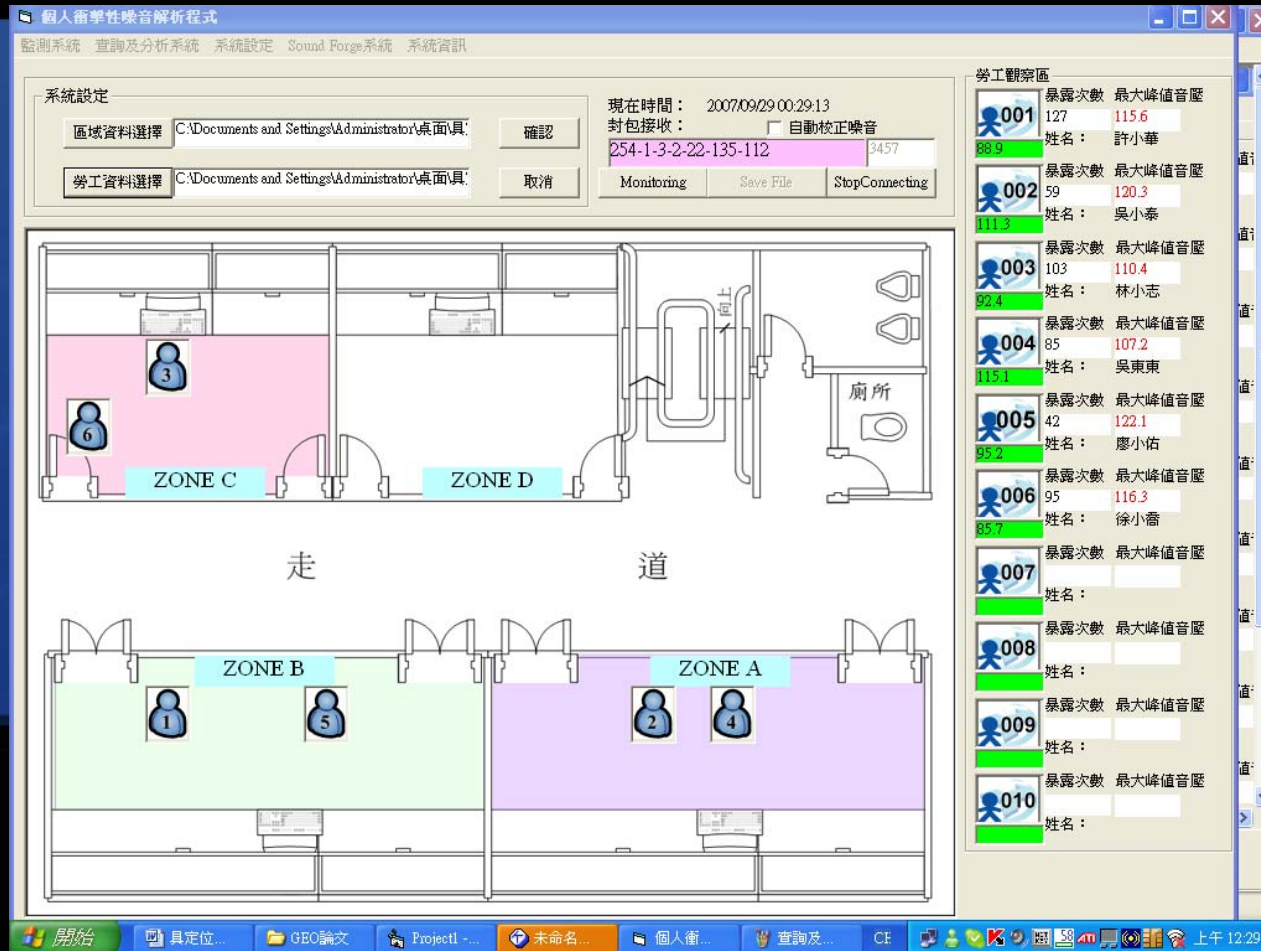


- Real-Time Noise Exposure
- Activity Monitor in Confined Space

Noise Exposure Study



Position and Exposure Levels



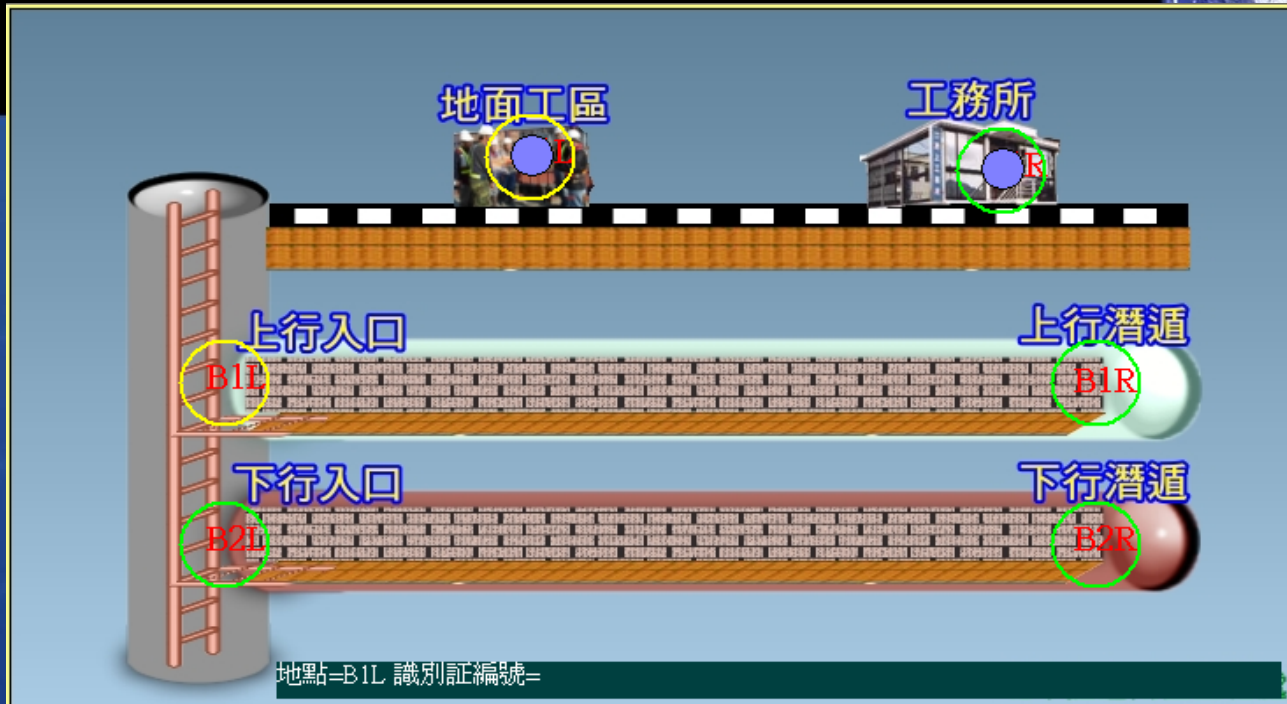
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Activity Monitor in Confined Spaces





Activity Monitor



事件時間	位置	編號	事件內容
2007/11/21 上午 11:47:31	G1R	2	勞研所,2,註冊,A2F,A2F,A2F,A2F,A2F,A2F,A2F,A2F,A2F,
2007/11/21 上午 11:47:31	G1R	3	勞研所,3,註冊,A2F,A2F,A2F,A2F,A2F,A2F,A2F,A2F,A2F,
2007/11/21 下午 03:52:00	G1L	4	勞研所,4,準許進入,G1L,2
2007/11/21 下午 03:53:46	G1R	5	勞研所,5,準許進入,G1R,1
2007/11/21 下午 03:57:37	G1R	7	勞研所,7,準許進入,G1R,1
2007/11/21 下午 03:55:24	G1R	8	勞研所,8,準許進入,G1R,1
2007/11/21 下午 03:57:39	G1R	9	勞研所,9,離場2007/11/21 下午 03:57:39
2007/11/21 下午 03:57:41	G1R	10	勞研所,10,準許進入,G1R,1

Entering
permitted area



Field Test Results



	Date	No. of pos. recorded by system	No. of pos. recorded by researcher
	11/23/2007	371	374
	11/27/2007	225	231
	11/28/2007	470	473
	11/29/2007	364	368
	TOTAL	1430	1446
	Success rate	98.89%	

Field Test Results



	Date	No. of path recorded by system	No. of path recorded by researcher
	11/23/2007	36	36
	11/27/2007	30	30
	11/28/2007	44	44
	11/29/2007	36	37
	TOTAL	146	147
	Success rate	99.32%	



WHAT'S NEXT

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3D Monitor



VIS, Virtual Inspector System for IOHA2008. Design by IOSH & SweetLAB 2008

Config Search Simulation Open Com Port Sound Exit

Select VisitorID

1	2	3	4
5	6	7	8

ID

VISITOR

Sexuality ☒ Male ☐ Female

Realtime

0008/2/18 下午 12:58:49

IN **OUT**

智慧無線環境應用實驗室 SweetLAB

IOSH 勞工安全衛生研究所

1. Stand on purple feet
2. Enter Your Name
3. Unplug USB ID on your right side
4. Wear the helmet
5. Move to the left on one step for check
6. Check the LED information

IOSH

Realtime Photo

	2	3	4
5	6	7	8

Visitor Status

0,0,0,0 **Visitor Photo**

Time	Position	ID	Event
12:56	Virtual Ins	1	John, 1, Access allow, Virtual Inspector, 2

Event Review



VIS, Virtual IOSH VISD查詢程式

開始時間: 2008 年 2 月 18 日 當日 00:00

結束時間: 2008 年 2 月 18 日 當日 23:59

查詢: 人數: 44 人 重置

時間: 從 2008-02-12 上午 09:34 至 2008-02-18 上午 11:58 查詢

序號	證件編號	姓名	性別	進場時間	離場時間
66	2	fchuang	男	2008/2/18 上午 11:56:52	2008/2/18 上午 11:58:25
65	1	Eric	男	2008/2/18 上午 11:44:12	2008/2/18 上午 11:47:25
64	1	Ht	男	2008/2/18 上午 11:23:10	2008/2/18 上午 11:25:17
63	1	o	男	2008/2/18 上午 11:13:33	2008/2/18 上午 11:15:50
62	2	Michael	男	2008/2/18 上午 11:02:13	2008/2/18 上午 11:05:08
61	1	John	男	2008/2/18 上午 10:58:08	2008/2/18 上午 11:00:01
60	1	John	男	2008/2/18 上午 10:46:43	2008/2/18 上午 10:47:42
58	1	John	男	2008/2/18 上午 10:00:55	2008/2/18 上午 10:02:30
57	1	John	男	2008/2/18 下午 09:54:45	2008/2/18 下午 09:56:09

基本資料
證件編號: 2 姓名: Michael 性別: 男 入場時間: 2008/2/18 上午 11:02:13 離場時間: 2008/2/18 上午 11:05:08

註冊畫面

操作時間	所在區域	操作行為
2008/2/18 上午 11:02:13	註冊區	完成註冊
2008/2/18 上午 11:02:54	虛擬檢查員	移動
2008/2/18 上午 11:02:57	虛擬檢查員	檢查成功
2008/2/18 上午 11:03:47	註冊區	移動
2008/2/18 上午 11:03:48	虛擬檢查員	移動
2008/2/18 上午 11:03:56	註冊區	移動
2008/2/18 上午 11:03:58	虛擬檢查員	移動
2008/2/18 上午 11:04:33	註冊區	移動
2008/2/18 上午 11:04:35	虛擬檢查員	移動
2008/2/18 上午 11:04:55	註冊區	移動

播放動畫

IOSH

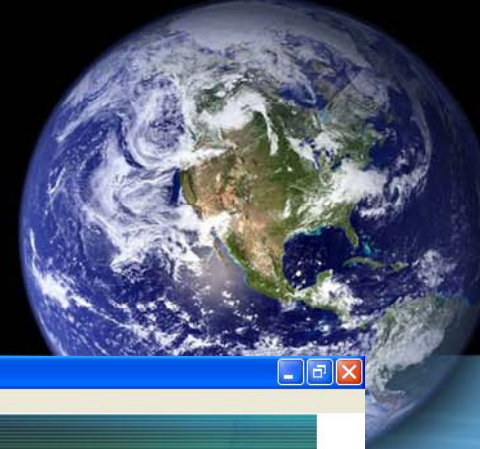
Realtime Photo

Visitor Status

Visitor Photo

Virtual Inspector, 2

Virtual Tour



Adobe Flash Player 9

檔案(F) 檢視(V) 控制(C) 說明(H)

核心成果展示展 Exhibition Hall

RFID Virtual Inspector System

Hi. 歡迎 Mr. Michael 先生



虛擬檢查員 Virtual Inspector

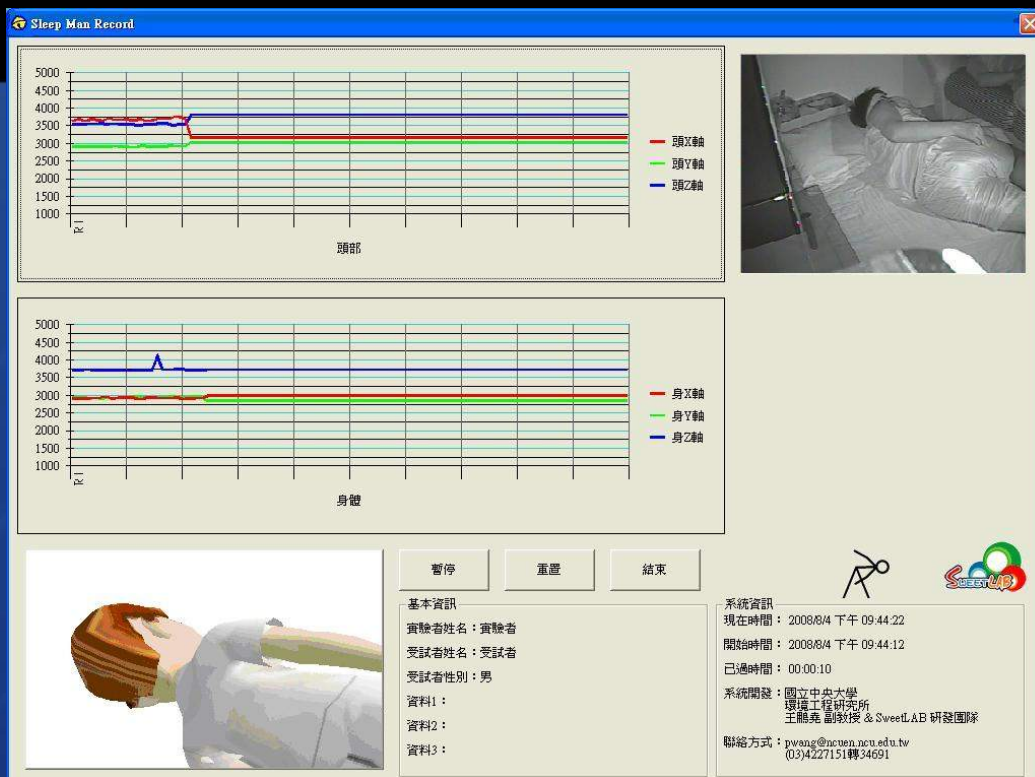
移動 => 檢查成功 => 移動 => 移動 => 移動

Developed by IOSH&NCU IOSH 勞工安全衛生研究所 INSTITUTE OF OCCUPATIONAL SAFETY & HEALTH
中央大學智慧無線環境應用實驗室 National Central University, Smart Wireless Environmental & Educational Technology.
LAB www.sweetlab.ncu.edu.tw

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智匯無線 無限智慧

Sleep Study



TAIWAN

Issues



- Too many data, not only kill your HD, also could kill you.
- How to determine the useful information from different activity patterns?
- Safety or privacy? which comes first?



- Special thanks to the IOSH, Taiwan and Mark Shih for his non-stop sponsoring of this research for a decade.
- Thanks to Dr. Harper for bring me here

• **THANK YOU FOR YOUR ATTENTIONS!**